APPARATUS AND METHOD FOR SCREENING OF WORKS IN RESPONSE TO INSPECTION RESULTS

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to apparatuses and methods for screening of works in response to inspection results produced by inspection apparatuses.

This application claims priority on Japanese Patent Application No. 2003-46894, the content of which is incorporated herein by reference.

Description of the Related Art

Conventionally, image processing apparatuses using CCD cameras (where 'CCD' stands for 'Charge-Coupled Device') are used to perform inspection on exterior appearances of various works such as chips including capacitors and inductors, which are used in a variety of electronic devices. Such inspection apparatuses inspecting exterior appearances of works are equipped with screening (or selecting or sorting) apparatuses for sorting inspected works into good products and defective products in response to inspection results, an example of which is disclosed in Japanese Patent Application Publication No. 2002-48725. That is, this screening apparatus operates in such a way that works whose exterior appearances are completely inspected by CCD cameras are transported to the outer circumferential portion of the upper surface of a rotary table via a transport path that is elongated downwardly in a slanted manner, wherein they are rotatably moved on the rotary table as it rotates. Herein, each work is discharged towards a prescribed position by use of a discharging device causing air blow in response to the inspection result thereof.

However, the aforementioned screening apparatus suffers from problems in that when a work is transported to the rotary table, it may unexpectedly fall down from

the rotary table, or it may roll or trundle on the rotary table and cannot be accurately set up to a prescribed position on the rotary table. This causes difficulties in accurately sorting works in response to inspection results.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an apparatus and method for screening of inspection-completed works, which can be reliably sorted and accurately transported to prescribed positions in response to inspection results.

A work screening apparatus of this invention basically comprises a 'slanted' slope way for sequentially transporting 'inspection-completed' works, a transport unit (e.g., a transport table) in which a plurality of work holding spaces for temporarily holding works being sequentially transported from the slope way are arranged at prescribed pitches therebetween so that the works are sequentially transported and which provides a leap inhibiting wall for inhibiting the works from unexpectedly leaping at a prescribed position between the slope way and the work holding space(s), and a discharge unit for discharging each of the works transported thereto from the transport unit at a prescribed discharge position in response to the inspection result thereof produced by an inspection unit.

That is, the work completed in inspection is forwarded to the work holding space of the transport unit via the slope way, then, it is further transported and discharged. In addition, this invention is characterized by providing the leap inhibiting wall between the slope way and the work holding space of the transport unit in order to inhibit the work from unexpectedly leaping towards the outside.

Therefore, even when the work is intensely transported from the slope way, it is possible to reliably and safely hold the work in the work holding space without causing leaping towards the outside. The work is transported by the transport unit,

and then, it is adequately discharged at the prescribed discharge position by the discharge unit in response to the inspection result thereof. Thus, it is possible to reliably sort and discriminate the works between good products and defective products. It is preferably set that the bottom area of each work holding space can be sufficient to hold a single work therein.

In the above, it is possible to provide a secondary transport section (e.g., a screening table) including a planar portion for receiving the work forwarded thereto, by which the work is transported to the prescribed discharge position, wherein the transport unit is installed in a hollow of a housing, so that the work holding spaces are encompassed between the circumferential wall and bottom wall of the hollow, and the bottom wall of the hollow is set to substantially the same height as the upper surface of the secondary transport section. Herein, an opening is formed to partially cut out the circumferential wall of the hollow and is located just above the upper surface of the secondary transport unit.

According to the aforementioned structure, it is possible to smoothly transport the works, which are sequentially transported to the transport unit via the slope way, towards the secondary transport unit. Herein, it is preferable to substantially match the bottom wall of the hollow of the housing with the upper surface of the secondary transport unit in height; alternatively, it is possible to arrange the bottom wall of the hollow to be slightly higher than the upper surface of the secondary transport unit. Thus, it is possible to prevent the work from being unexpectedly deviated in position and from rolling; and it is possible to reliably transport the work with an appropriate position towards the secondary transport unit.

In addition, a gap is arranged between the side surface of the transport unit and the circumferential surface of the hollow, in other words, between the opening of the work holding space and a part of the transport unit for forwarding the work to the

secondary transport unit, whereby it is possible for the work to be caught between the transport unit and the housing as the transport unit is subjected to rotation. Due to the provision of the aforementioned gap, the transport unit can be subjected to smooth rotation not to directly contact with the circumferential surface of the hollow of the housing.

Furthermore, an escape channel allowing the work to escape is arranged in the downstream side of the transport unit that is subjected to rotation relative to the secondary transport unit, so that the work that fails to be transported to the secondary transport unit can be safely discharged to the outside via the escape channel.

In the above, when the transport unit fails to transport the work to the secondary transport unit so that the work still remains in the work holding space, it is possible to safely discharge the work to the outside via the escape channel. That is, it is possible to avoid occurrence of an event in which the work, which fails to be transported to the secondary transport unit and still remains in the work holding space, blocks another work, which is newly introduced from the slope way, from being entered into the work holding space, and an event in which multiple works are mistakenly entered into the same work holding space. Thus, it is possible to avoid occurrence of an incompatible event in which the inspection results are not sequentially produced in conformity with the aligned order of the works due to the failure to discriminate the aligned order of the works.

Moreover, the transport unit and the secondary transport unit mutually match each other in the relative moving speed thereof at the prescribed position at which they meet each other; and the discharge unit can discharge the work being transported thereto from the secondary transport unit. That is, substantially the same relative moving speed is secured at both of the position for locating the work in the transport unit and the position for receiving the work in the secondary transport unit. Thus, it is

possible to smoothly transport the work from the transport unit to the secondary transport unit (i.e., from the transport table to the screening table) without trouble.

A work screening method of this invention basically comprises three steps, namely, a first transport step for sequentially transporting inspection-completed works via the slope way, a second transport step for independently putting the works, which are sequentially transported from the slope way, into a plurality of work holding spaces, which are sequentially located close to the slope way and are arranged at prescribed pitches therebetween and each of which is associated with a leap inhibiting wall for inhibiting the work from leaping outside therefrom, and a discharge step for discharging each of the works at a prescribed position in conformity with its inspection result.

According to the work screening method, each of the works sequentially forwarded from the slope way to the transport unit can be reliably and safely held inside of each of the work holding spaces without unexpectedly leaping outside of the transport unit; therefore, each of them can be reliably subjected to transportation by the transport unit and subjected to screening in the discharge unit.

In the above, it is characterized in that the time period in which the transport unit moves by one pitch corresponding to one work holding space is set shorter than the time interval in which each work is forwarded from the slope way. That is, even when the next work is supplied from the slope way at an intermediate position between the adjoining work holding spaces, the next work holding space comes shortly to safely hold the next work therein. Thus, it is possible to reliably avoid occurrence of an event in which the work fails to be held in the work holding space or an event in which multiple works are mistakenly held in the same work holding space. That is, it is possible to prevent the work from leaping outside of the transport unit; and it is possible to avoid occurrence of failure in discriminating the aligned order of the works

because multiple works can be reliably prevented from being mistakenly held in the same work holding space.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, aspects, and embodiments of the present invention will be described in more detail with reference to the following drawings, in which:

FIG. 1 is a front view showing an exterior appearance inspection apparatus equipped with a screening unit in accordance with a preferred embodiment of the invention;

FIG. 2 is a plan view showing the screening unit;

FIG. 3 is a side view showing the screening unit;

FIG. 4A is a plan view showing a housing having a hollow for holding a transport table therein;

FIG. 4B is a cross sectional view taken along line A-A' in FIG. 4A;

FIG. 5 is a perspective view showing a work that is subjected to inspection and screening; and

FIG. 6 is a cross sectional view showing the internal structure of the screening unit associated with a work shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

This invention will be described in further detail by way of examples with reference to the accompanying drawings.

FIG. 1 is a front view showing an exterior appearance inspection apparatus 10 equipped with a screening unit 40 in accordance with a preferred embodiment of the invention. The lower portion of the exterior appearance inspection apparatus 10 is constituted by a base 12 having a square plate like shape on which a rail 11 is laid. A

work supply unit 20, an inspection unit 30, and the screening unit 40 are arranged on the upper surface of the base 12 such that their positions can be freely adjusted along the rail 11 in left-right directions in FIG. 1.

The lower portion of the work supply unit 20 is constituted by a moving carriage 21 engaged with the rail 11, whereby by moving the moving carriage 21 along the rail 11, it is possible to set the work supply unit 20 to an arbitrary position on the base 12. In addition, the moving carriage 21 can be adjusted in three-dimensional positioning by adjusting screws (not shown) in such a way that it can move up or down in a vertical direction, and it can move forward and backward in a direction perpendicular to the sheet of FIG. 1 (in which the front side designates a forward direction). A vibration generator 22 having a motor is attached onto the upper surface of the moving carriage 21. A feeder 23 for transporting a work 15 (see FIG. 5) to the inspection unit 30 is attached onto the upper surface of the vibration generator 22. The tip end portion of the feeder 23 projects and is elongated towards the inspection unit 30.

A hopper 24 for temporarily holding the work 15 is arranged on the feeder 23, and a supply chute 25 for supplying the work 15 held in the hopper 24 to the feeder 23 is arranged at one lower end portion of the hopper 24. That is, when the vibration generator 22 is driven while the hopper 24 is supplying the work 15 towards the feeder 23, the feeder 23 is vibrated such that the work 15 is moved towards the inspection unit 30. Thus, a series of works are linearly aligned and are sequentially moved towards the tip end portion of the feeder 23.

The inspection unit 30 is installed in the exterior appearance inspection apparatus 10 in such a way that the main body thereof for performing inspection is arranged on the upper surface of a moving carriage 31, which is engaged with the rail 11 and which can be fixed at an arbitrary position along the rail 11 on the base 12.

The upper-side portion of the moving carriage 31 is slightly bent towards the tip end portion of the feeder 23 of the work supply unit 20. A base plate 32 having a flat plate like shape is attached to the upper end of the upper-side portion of the moving carriage 31 such that the upper surface thereof is inclined towards the feeder 23. A discharge chute 33, which serves as a slope way (or a ramp) for discharging the 'inspection-completed' work 15 from the inspection unit 30, is attached to the center area of the base plate 32. In addition, a transmission hole 34 is formed to penetrate through the center area of the base plate 32 so as to pick up an image of the lower surface of the work 15.

The discharge chute 33 is attached to the circumferential portion of the transmission hole 34 in the side of the moving carriage 31, wherein the surface thereof is formed like a channel whose cross section corresponds to a semicircular shape. A cylindrical interconnection member 35 equipped with various members for picking up images on respective sides of the work 15 is attached onto the upper surface of the base plate 32, wherein it forms a path interconnecting the feeder 23 and the discharge chute 33 together.

Four CCD cameras 36a and 36b (for the sake of convenience, FIG. 1 shows only two cameras; however, there are actually provided four cameras) are arranged at equal intervals therebetween along the circumference surrounding the interconnection member 35 in order to pick up images of the work 15, which is falling down from the tip end portion of the feeder 23, from its respective sides. In addition, two CCD cameras 36c and 36d are arranged respectively on the upper side and lower side of the interconnection member 35 in order to pick up images of the work 15 with respect to its upper surface and lower surface. That is, the present embodiment is designed to pick up images of the work 15 in six sides. Of course, the present embodiment can be modified to provide the four CCD cameras 36a and 36b only, thus realizing inspection

on four sides of the work 15. Alternatively, it can be modified to combine the four CCD cameras 36a and 36b with an additional CCD camera for picking up an image of the upper or lower surface of the work 15, thus realizing inspection on five sides of the work 15.

A reflection mirror 38a is arranged above the upper surface of the interconnection member 35 via a bracket 37a. That is, the CCD camera 36c can pick up an image of the upper surface of the work 15 by means of the reflection of the reflection mirror 38a. Similarly, a reflection mirror 38b is arranged below the lower surface of the base plate 32 via a bracket 37b, so that the CCD camera 36d can pick up an image of the lower surface of the work 15 by means of the reflection of the reflection mirror 38b.

The screening unit 40 is controlled by a control device (not shown) based on image pickup results produced by the CCD cameras 36a, 36b, ..., so that it accomplishes screening of the works 15. Details of the screening unit 40 are shown in FIGS. 1 to 3 and FIG. 6, wherein the screening unit 40 comprises a moving carriage 41 in the lower side thereof as well as a transport table 42 and a screening (or sorting) table 43 in the upper side thereof. The moving carriage 41 is engaged with the rail 11 in such a way that it can be adjusted in position along the rail 11 on the base 12. Specifically, it contains a drive mechanism 44 having an electric motor for rotatably driving the transport table 42, and a drive mechanism 45 having an electric motor for rotatably driving the screening table 43.

The transport table 42 is installed in a housing 46 that is arranged on the terminal portion of the upper surface of the moving carriage 41 in the side of the work supply unit 20. It comprises a gear-like rotating body having teeth and notches 47, which are alternately and circumferentially arranged with prescribed pitches therebetween. A center shaft 48 of the rotating body is interconnected with a drive

shaft 44a of the electric motor of the drive mechanism 44, so that the transport table 42 rotates in a clockwise direction 'a' (viewed from the upper side of the screening unit 40) upon the driving of the electric motor. Herein, each of the notches 47 is formed in such a way that the upstream side surface thereof (viewed in the rotating direction of the transport table 42) lies along a diameter direction of the transport table 42, and the downstream side surface thereof is slanted towards the downstream side of the transport table 42.

A circular hollow 49 is formed on the upper surface of the housing 46, so that the transport table 42 is stored in the hollow 49 in a rotatable manner. A work holding space 50 is encompassed by a circumferential wall 49a and a bottom 49b of the hollow 49 (see FIG. 4 and FIG. 6) as well as each notch 47 of the transport table 42, so that a plurality of work holding spaces defined by the notches 47 are circumferentially arranged around the transport table 42 in the hollow 49. Herein, the area of a part of the bottom 49b defined by each notch 47 is set to be sufficiently greater than a prescribed area accommodating one work 15 therein.

A hole 46a communicated with the lower end portion of the discharge chute 33 is formed at one end of the housing 46. That is, the slope way of the discharge chute 33 is communicated with the inside of the hollow 49 (i.e., the inside of the work holding space 50) via the hole 46a. Incidentally, the circumferential wall 49a of the hollow 49 and the transport table 42 are respectively set to prescribed heights or higher places so as to reliably prevent the work 15, which is forced to be intensely discharged from the discharge chute 33, from being running out. This constructs a leap inhibiting wall for inhibiting the work 15 from unexpectedly leaping.

For example, when the work 15 has prescribed dimensions defined as 1mm× 0.5mm×0.5mm, it is preferable that both of the height of the circumferential wall 49a of the hollow 49 and the height of the transport table 42 are set to 20 mm or more. In

addition, as shown in FIG. 4B and FIG. 6, the transport table 42 is arranged inside of the hollow 49 with gaps 49d thereabout against the circumferential wall 49a so as to prevent the work 15 from being accidentally caught between the housing 46 and the transport table 42; specifically, the gaps 49d are formed at prescribed positions communicating with the hole 46a in proximity to the periphery of the hollow 49 in association with the transport table 42, which rotates in the direction 'a' so as to transport the work 15 towards the screening table 43, so that the work 15 being transported can be reliably prevented from being accidentally caught between the housing 46 and the transport table 42. The gaps 49d are formed on the wall 49a in an area corresponding to at least the portion near the hole 46a; specifically, the gaps 49d are formed on the wall 49a in an area ranging from at least the portion near the hole 46a towards the portion near the screening table 43 in the direction 'a'. In this case, it is preferable that the height measured between the bottom 49b of the hollow 49 and the lower end of the gap 49d is set to 8 mm or more.

As shown in FIG. 4, the counter portion of the bottom 49b of the hollow 49 arranged opposite to the screening table 43 is cut in an arc-like shape, wherein the transport table 42 partially projects out from the bottom 49b and is therefore located above the screening table 43. In addition, an escape channel 49c, which serves as an escape portion (or a bypass portion) in this invention and whose tip end portion is located downwardly (see the left-side portion in FIG. 4), is formed along the outer circumference of the cutout portion of the bottom 49b in the downstream side of the rotating direction of the transport table 42. Furthermore, a work retrieval section (not shown) for retrieving the work 15, which is transported thereto via the escape channel 49c, is arranged in the lower end portion of the escape channel 49c. Therefore, when the work 15 is transported via the discharge chute 33 while the transport table 42 is rotating upon driving of the drive mechanism 44, the work 15 is introduced into the

work holding space 50 via the hole 46a and is rotatably moved on the bottom 49b of the hollow 49 as the transport table 42 is rotating.

The screening table 43 is interconnected to a drive shaft 45a of the drive mechanism 45 via a center shaft 51 thereof. The upper surface of the screening table 43 is lowered in elevation compared with the bottom 49b of the hollow 49, so that the screening table 43 rotates in an arrow direction 'b' (i.e., the counterclockwise direction viewed from the upper side in FIG. 2) as the outer circumferential portion thereof substantially matches the cutout portion of the bottom 49b of the hollow 49. A work receiving section 43a is arranged in the peripheral portion on the upper surface of the screening table 43 in order to receive the work 15 being transported by the transport table 42. The work receiving section 43a is made of a rubber plate so as to prevent the work 15 from slipping thereon.

A position detection sensor 52 is arranged at a prescribed position above the screening table 43 close to the transport table 42 so as to detect the work 15 being transported onto the screening table 43. In addition, four air exhaust devices 53a, 53b, 53c, and 53d are arranged at prescribed distances therebetween above and along the outer circumferential portion of the screening table 43 opposite to the transport table 42. Furthermore, a good product storage box and a defective product storage block (not shown) are arranged under the terminal end portion of the screening table 43 vertically opposite to the air exhaust devices 53a, 53b, 53c, and 53d.

The screening table 43 receives the works 15 sequentially transported thereto by the transport table 42, so that the works 15 are circumferentially arranged on the upper surface of the work receiving section 43a at prescribed distances therebetween; then, they are delivered to the aforementioned boxes respectively. Specifically, when the work 15 is discriminated as a good product based on its inspection result produced by the inspection unit 30, the air exhaust device 53a, for example, is activated to blow

out the work 15 into the good product storage box as the work 15 passes over the good product storage box. When the work 15 is discriminated as a defective product, the air exhaust device 53b, for example, is activated to blow out the work 15 into the defective product storage box as the work 15 passes over the defective product storage box. Thus, it is possible to discriminate the works 15 between the good products and defective products, which are accurately delivered to the good product storage box and defective product storage box respectively. The other air exhaust devices 53c and 53d are adequately activated to blow out the works 15 into the corresponding boxes in response to degrees and types of defectiveness.

The exterior appearance inspection apparatus 10 further comprises electric control devices such as the CPU, ROM, and RAM as well as an image processing device including the CCD cameras (e.g., 36a) other than the aforementioned electromechanical components. The image processing device performs image processing on images picked up b y the CCD cameras (e.g., 36a) so as to discriminate the works 15 between the good products and defective products. In addition, the image processing device is equipped with a display screen for magnifying and displaying the six sides (or hexagonal structure) of each work 15; therefore, a human operator can watch the images to visually judge whether or not the work 15 is a good product or a defective product.

Next, a description will be given with respect to the exterior inspection and screening for an example of the work 15 (see FIG. 5) to be inspected such as a capacitor chip using the aforementioned exterior appearance inspection apparatus 10. Prior to inspection, the works 15 are held in advance in the hopper 24 of the work supply unit 20; then, a power switch (not shown) of the exterior appearance inspection apparatus 10 is turned on, so that the aforementioned units and devices are respectively activated to perform prescribed operations thereof. In the work supply unit 20, the

prescribed number of works 15 are supplied to the feeder 23 from the hopper 24 via the supply chute 25.

Each of the works 15 supplied to the feeder 23 are forwarded to the tip end portion of the feeder 23 upon driving of the vibration generator 22, so that it is discharged into the space from the tip end portion of the feeder 23. As the work 15 passes through the center portion of the interconnection member 35 and falls down, the CCD cameras 36a to 36d pick up images with respect to respective sides of the work 15, thus photographing images. Based on images regarding six sides of the work 15, the image processing device operates to discriminate whether or not the work 15 is a good product or a defective product. Discrimination is performed upon comparison for the 'photographed' work 15 with respect to the prescribed criterion regarding the exterior dimensions, dirt, flaws, and abnormal substances being adhered or not. In this case, the 'magnified' images picked up with respect to the six sides of the work 15 are displayed on the screen of the image processing device; therefore, a human operator can detect the defectiveness on any part of the work 15.

The work 15 that is discriminated between a good product and defective product is fallen down into the discharge chute 33, along which it descends down and is then fallen down into the work holding space 50 of the screening unit 40 via the hole 46a. Due to the formation of the leap inhibiting wall surrounding the work holding space 50, even when the work 15 has intensely fallen into the work holding space 50, it is possible to reliably set the work 15 into the work holding space 50. Thereafter, the work 15 is transported towards the screening table 43 by the transport table 42.

In the above, the rotating speed of the transport table 42 is set in such a way that the time period in which the transport table 42 rotates by one pitch (corresponding to one work holding space 50) becomes shorter than the time interval in which each work 15 is being transported from the discharge chute 33. Thus, it is possible to

prevent multiple works from being put into a single work holding space 50; that is, it is possible to reliably put a single work 15 into each work holding space 50, which is thus occupied or empty as necessary.

When the work 15 is rotatably transported to the prescribed position of the hollow 49 opposite to the screening table 43 as the transport table 42 rotates, due to the aforementioned cutout portion of the bottom 49b of the hollow 49, the work 15 naturally falls onto the upper space of the screening table 43 and is then rotatably transported as the screening table 43 rotates. Herein, the upper surface of the screening table 43 is lowered in elevation compared with the bottom 49b of the hollow 49; therefore, it is possible to smoothly transport the work 15 from the transport table 42 to the screening table 43.

At the prescribed position of the hollow 49 at which the transport table 42 meets the screening table 43, the opening direction of the aforementioned notch 47 of the transport table 42 substantially matches the relative moving direction of the screening table 43 in which the work 15 is being transported; therefore, it is possible to reliably and completely perform transport of the work 15. In this case, both of the transport table 42 and the screening table 43 have substantially the same speed in rotation at the prescribed position of the hollow 49 at which the transport table 42 meets the screening table 43. Incidentally, when the transport table 42 fails to safely transport the work 15 onto the screening table 43, the work 15 automatically escapes towards the work recovery section via the escape channel 49c.

Good products among works 15 being sequentially transported close to the aforementioned boxes by the screening table 43 are respectively blown out by the air exhaust device 53a towards the good product storage box, while defective products are blown out by the air exhaust device 53b towards the defective product storage box. Thus, it is possible to reliably and accurately discriminate the works 15 between good

products and defective products, which are adequately sorted and delivered to the corresponding boxes. Herein, the works 15 supplied onto the upper surface of the screening table 43 are sequentially transported under the position detection sensor 52 under which the positions thereof are sequentially detected; then, they are blown out by the air exhausted by the air exhaust device 53a.

In the aforementioned screening unit 40, the 'inspection-completed' work 15 is temporarily held in the work holding space 50 defined by the transport table 42; then, it is transported onto the screening table 43. In addition, the leap inhibiting wall is arranged in the path between the discharge chute 33 and the work holding space 50 in order to prevent the work 15 from leaping off therefrom. Thus, it is possible to reliably prevent the work 50 from unexpectedly leaping towards the outside as the work 15 is transported from the discharge chute 33 onto the transport table 42; therefore, the work 15 can be reliably and safely held in the work storage space 50.

The present embodiment is designed such that the bottom 49b of the hollow 49 is set at a height substantially matching the upper surface of the screening table 43, and both of the transport table 42 and the screening table 43 are set to substantially the same speed in rotation at the prescribed position at which the transport table 42 meets the screening table 43. In addition, the opening direction of the notch 47 of the transport table 42 substantially matches the relative moving direction of the screening table 43 in which the work 15 is moved thereon at the prescribed position at which the transport table 42 meets the screening table 43. Therefore, it is possible to smoothly transport the work 15 from the transport table 42 to the screening table 43. As a result, it is possible to accurately sort the works 15 between good products and defective products.

The present embodiment is designed to provide two tables, i.e., the transport table 42 and the screening table 43, however, it is possible modify the present

embodiment such that the works 15 are subjected to direct screening (or direct sorting) by means of the transport table 42. In addition, the present embodiment constitutes the screening table 43 as a rotary table, which is not necessarily restricted. Therefore, it is possible to use a linear conveyer in order to increase the screening speed for the works 15 and to reduce influences due to centrifugal force. Furthermore, it is possible to use a linear conveyer that replaces the transport table 42 to secure revolution of the screening table 43.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalents of such metes and bounds are therefore intended to be embraced by the claims.